

## THE QUICK METHOD OF CONSTRUCTING STRIP FOUNDATIONS WITH LONGITUDINAL SOCKET

### TECHNICAL FIELD

The present invention relates to the construction of foundations for industrial buildings or  
5 other similar buildings of reinforced concrete and in particular to some pre-cast parts  
which become integral parts of the foundations.

### FIELD OF THE INVENTION

The present invention concerns constructing of special strip foundations with a  
longitudinal socket-groove intended for large-span building structures with walls formed  
10 of upright-standing, load-bearing, cantilever panels supporting roof construction with or  
without intermediate floor constructions. In particular, the invention deals with a method  
and apparatus for constructing the below-ground building of said foundation.

### BACKGROUND OF THE INVENTION

In a traditional foundation constructing process the building foundation is formed of  
15 poured concrete which takes several days and many man-hours to complete. The  
present invention, greatly streamlines the traditional process reducing it to a one-day  
process requiring the crane, some specialized equipment and only a few workers for a  
greatly simplified task of preparing such a foundation.

A traditional procedure, which is here briefly described in order to be compared with the  
20 present invention, commences with a trench dug into the ground, below the frost line to  
the required depth, around the perimeter of the building layout. In the next step a thin  
concrete cover is poured over the bottom of the trench, which takes at least one day  
delay while waiting its concrete to harden, to assure the flat and clean surface upon  
which the welded mesh reinforcement of the strip footing and reinforcement of the  
25 longitudinal channel (or sockets) can be neatly placed. Being done so, concrete ready  
mix trucks deliver concrete to the building site and pour the footing strip plate. Thus  
poured concrete is then given an additional day to cure before subsequent steps are  
undertaken. After the concrete of the strip footing plate is hardened, if not before done,  
the reinforcement is to be completed. In the next step, side forms are installed to close  
30 the space of the two thin walls of the longitudinal socket channel. Finally, the socket  
channel is poured and several further days of curing are needed for concrete to get  
hardened enough to be ready for receiving panels.

A long and thin strip comprising a longitudinal socket-groove is not simply carried out  
and accurately levelled without plenty of man labour-hours on building site such as;

raising huge amount of forms and levelling the same, placing reinforcement, concreting in two stages (footings and socket separately), and other activities, whereby weather-related problems may delay various steps of the constructing process.

The invented method being a substitute for traditionally cast in site strip foundations comprises several benefits compared to former methods in accomplishing the task of constructing foundations. As there is always a need to streamline the process, the traditional procedure is by the present application fastened and made a less labour-time consuming method by using pre-cast concrete channels which are delivered to the building site, properly levelled by an adequate apparatus and poured at once. A quicker and easier way, offered by this invention, leads thereby to significant savings in labour and material making the entire process of constructing foundations less dependent on weather conditions.

#### SUMMARY OF THE INVENTION

As afore described, rapid and economic constructing of the strip foundations with longitudinal socket for the above mentioned type of structure is a general subject of this invention though the same method and apparatus can be used to construct several different types of foundations. A typical load-bearing panel-assembled wall, mounted over strip foundations serving the purpose of supporting this particular type of structure is shown in Fig.1. Tall and slender wall-panels (1) are inserted into grooves of longitudinal sockets along the perimeter of the building, temporarily levelled and fixed thereto by wedges, being in sequel lastingly fixed by concrete poured into the gap between the panels and thin walls of the groove, in a most common way.

This invention hence, contemplates quick disposition of such long pre-cast reinforced concrete elements over the trench, which, hanging there temporarily held in predetermined position upon a plurality of holding devices until all (or by parts) elements are gathered and fine levelled. Being thus arranged and firmly fixed, pre-cast elements are lastingly incorporated into poured in site strip-footing concrete, becoming a part of the foundation, as seen from Fig.2.

In most common skeleton systems of the prior art, columns or frames bearing roof/floor constructions are supported by single footing foundations whereby concentrated forces and bending moments are transmitted to footings. By the present system whereby wall-panels, being arranged and loaded continuously along the strip foundation, vertical forces and bending moments are transmitted rather uniformly (distributed per unit length) over foundation. Compared to single foundations, the longitudinal strip

foundations, due to reduced, essentially lower pressure at the concrete to ground contact surface can be carried-out at a smaller depth whereby continuous distribution of forces and bending moments along the strip length enables also application of thinner and wider dimensions of the footing strip.

- 5 Longitudinal socket-grooves ensuring fixed-end wall-panels to foundations connection, require the most accurately levelling of the common bottom, so is advantageous to cast them in factory under stable circumstances such as; precise moulds, with presence of all necessary tools at one place and not reliant upon weather conditions.

Use of pre-cast socket units delivered to the building site avoids a problem about their  
 10 accurate placement and levelling along the entire formed channel, composed of a plurality of such units, prior to concrete of the strip footing being poured. For that purpose, to complete the entire socket-channel as well as to assure a neatly prepared, horizontally perfectly levelled continuous longitudinal channel, the holding devices as illustrated in Fig. 7 are used. Each pre-cast element is temporarily held by a couple of  
 15 such devices as illustrated in Fig.4. Disposed in that way, a plurality of recast elements assembled into a channel entirety hang over the trench bottom at a predetermined depth. Thus formed the hanging longitudinal socket, the bottoms of ends of adjacent elements can be positioned perfectly close, rendered compatible each to another so as to be levelled by the same devices. Referring now to the Fig.4, the adaptable-length truss-  
 20 girders of holding/levelling devices (5), bridge the trenches leaned against two supports (6), each being supplied by hydraulic lifting presses for up/down levelling. The lateral inclination of the pre-cast element within the trench is avoided by hanging upon two vertical rods of previously equalized length. The longitudinal inclination of the element is controlled by lifting presses at supports. Movement in direction of the axis of the element  
 25 as well as lateral translational movement is enabled by rollers between the housing of the hydraulic pressures and the support pads. Finest horizontal movements in both horizontal directions are performed by sliding the housing of the support upon the support pad by hydraulic or similar means.

To obtain a proper connection between the pre-cast socket element and the strip poured  
 30 in site an adequate amount of reinforcement projecting from the bottom of the precast element must be provided, as seen in Fig.2. The precast element must be as well supplied with a certain amount of longitudinal reinforcement which assures small deflections due to lifting and transportation of the element as well as for standing over

the trench. After precise levelling, such temporary hanged socket construction is poured by a fresh concrete being in that way lastingly fixed.

The main object of the invention is to provide foundation elements and techniques that greatly facilitate and fasten the preparation of a building foundation of that type. A further object is achieved by features of the invention that permit a reduction in the manpower required to construct the foundation. It is comprehensible; if pre-cast elements were of 12 m approximate length, that only a few skilled workers are enough to construct several hundred meters length of finished foundations a day. A further benefit resides in the configuration of the pre-cast elements that can be combined in a variety of ways to create a wide range of foundation layouts by a set of pre-cast socket-channel components which can be provided and carried to the job site for rapid assembly.

The invention is particularly applicable to the construction of foundations for large span industrial and similar buildings although the same components and techniques can be utilized for any other buildings comprising strip foundations of the likely type.

#### DESCRIPTION OF DRAWINGS

##### Fig 1

Is a perspective view of the typical building supported by strip foundation with longitudinal socket groove as in the present invention.

##### 20 Fig 2

Is a cross-sectional view of a finished foundation, showing the pre-cast element incorporated as an integral part to strip footing.

##### Fig 3

Is a perspective view of the pre-cast element.

##### 25 Fig 4

Is a perspective view of the foundation building site patch, illustrating the constructing process whereby the current pre-cast element still hanging upon the crane, supplied with holding/leveling devices is positioned to the trench prior to being levelled and a strip footing plate of foundation is poured.

##### 30 Fig 5

Is a cross-sectional view, illustrating the constructing process stage whereby the pre-cast element temporarily hanging over the trench is supplied by a horizontal bolt and two upright rods, before being re-hanged to the truss-girder.

Fig 6

Is a cross-sectional view, illustrating the constructing process stage whereby the pre-cast element temporarily hanging over the trench is hanged to the truss-girder, being previously levelled, awaiting concreting of the strip footing.

5 Fig 7

Is a perspective view of the holding/levelling device showing its constitutive parts.

#### DESCRIPTION OF THE PREFERRED EMBODIMENT

A typical load-bearing, wall-panel assembled structure mounted over strip foundation with longitudinal socket-groove, which is the subject of the present invention, is shown in  
10 Fig1. Generally, such foundations, serving to receive and support this particular type of construction, comprise continuous longitudinal socket-grooves (3) along the entire strip footing (4) length. The vertical load bearing panels (1) supporting roof construction (also possible one or more intermediate floor constructions simultaneously) are in fact thin walled, widely-shaped, closing the interior of a building, cantilever columns with their  
15 lower ends firmly fixed into a longitudinal foundation socket (3) with their upper ends free to lean the floor building elements against.

The pre-cast socket components (3), as shown in Fig.2, replacing the traditionally cast in site longitudinal socket, which would be, if traditionally constructed, the most time-consuming part of constructing the foundations are hereby delivered to the building site  
20 and promptly placed within prepared trenches, as illustrated in Figs. 4, 5 and 6. As a first step, the trench (8) of the predetermined width and depth according to the local soil conditions and site considerations is excavated below the frost line, around the perimeter of the building layout. Wide and shallow trenches are dug using an adequate excavator. The cross-sectional view of the trench shape is shown in Fig.2. In very  
25 coherent soils the preferred trench shape would be as denoted by dashed line. The smaller the soil coherence is the more inclined trench lateral sides will be needed to prevent their sliding. In most cases, except in case of extremely incoherent soils, it is possible to obtain the firm earth sides near the trench bottom whereto the strip-footings are poured so that no additional lateral forms are needed, as obvious in Fig.2. Once the  
30 trench was dug the foundation constructing process, supported by proper equipment and skilled man-power, proceeds in a quick and continuous way with small number of workers.

As illustrated in Fig.4, the crane (10) of a suitable capability moves along the trench side being continuously supplied by pre-cast socket units (3) delivered by a transportation



vehicles (11) to the building site. A small group, of about four workers, disposed around the trench, following the crane, perform fixing holding/levelling devices to the pre-cast longitudinal socket units. Thus, still hanging upon the crane slings, the pre-cast socket unit (3), being furnished by two devices (5) each, become in that way capable of standing upon them over the trench, whereto it is placed by the crane, with assistance of the same group. Thus being positioned, the crane slings are removed and the work proceeds by the crane taking the next element. Element (12) being already positioned into the trench in the described manner is subsequently adjusted and levelled by another group of workers by features of holding/levelling devices. In sequence, fresh truck-mix delivered concrete, following after the levelling group, is poured into the trench below the hanging pre-cast socket elements (13) ,which, as illustrated in Fig.4, form the footing of the strip footings (4), joined with the pre-cast element (3) firmly through its protruding reinforcement (3.3) according to the Fig.2. Moving onward, in above briefly described manner, along the trench, the procedure takes no more than fifteen minutes per twenty meters of finished foundation length (twenty meters is a length of the pre-cast unit). Thus organized, with skilled workers, under conditions of absent interruptions or any disturbance, the procedure is performed even with approximate 1m/1minute speed which means 60 meter per hour.

The procedure is now described more precisely, containing necessary details, in the sequence. The holding/levelling device (5), shown in Fig.7, comprises the main truss-girder (5.1) of a length some longer than the trench-width, with extendable ends (5.2), leaned against saddles (6.5) on top of a pair of adjustable supports (6), positioned at each side of the trench as shown in Fig.6. The light-weight trusses (5.1) easy-carried by two man are thereby used to bridge the trench over, holding the hanged pre-cast channel element (3) within the trench (8) above its bottom. Both supports (6) comprise hydraulic lifting presses (6.1) used for upward/downward movement placed within the steel housing (6.2) with enlarged basis (6.3), enabled to slide in two horizontal perpendicular directions. The extended basis (6.3) of the housing is leaned against the support pad (6.4) through set of rollers whose movement is limited within the pad area (intentionally omitted here considered as being of a secondary importance for the present invention).

The pre-cast socket element (3) hangs on two rectangular-shaped horizontal bolts (7) pulled through rectangular-shaped holes (3.2) in both of its thin walls. The rectangular-

shaped holes (3.2) are used instead of rounded to prevent the bolt to rotate around its axis enabling in that way their upright attitude when rigged to the pre-cast element (3).

The horizontal bolt (7) is hanged upon two vertical rods (5.3) pulled vertically through holes of the main truss-girder (5.1) symmetrically about the midspan. The length of both rods (5.3) is adjustable for purpose of reaching the necessary height-position of the pre-cast element (3) over the bottom of the trench. The chosen length of both vertical rods (5.3) between the top of the truss-girder (5.1) and the desired level of the horizontal bolt (7) is fixed by two nuts (5.4). Being thus fixed, at some level, by nuts (5.4), on both devices simultaneously, the hanging pre-cast element hangs without lateral inclination and is ready to be levelled.

For purpose of lifting and handling, each pre-cast element comprises two pairs of holes through its thin walls positioned near quarters of its length, inner (3.1) and outer (3.2), as illustrated in Fig.3. The inner pair of holes (3.1) is used to rig the pre-cast element to the crane slings. In a procedure, as illustrated in Fig.4, being rigged by bolts at inner holes (3.1) the pre-cast element is hoisted from the truck by crane, which turning to the trench side keeps holding the hanged element (3) on slings over the trench until workers pull the bolt (7) through both end holes (5.5) of two vertical rods (5.3) and holes (3.2) in both element (3) walls. Both vertical rods (5.3) (standing now uprightly because of their prevented rotation by rectangular shaped bolt, as afore said), the crane gradually sinks the pre-cast socket element (3) into the ditch until the top of vertical rods got inside of reach of the workers hands. The truss-girder (5.1) is then connected to both vertical rods (5.3) being fixed thereto by nuts (5.4) and leaned against supports (6). Now hanging upon two holding/levelling devices supported at each side of the trench the pre-cast element (3) can be relieved from the crane slings. To assure access to the device a board (15) over the trench is used.

The precise levelling is carried-out after pre-cast channel elements have been, temporarily rather roughly arranged. Prior to levelling, the accurate position of the currently placed element is obtained by moving the same at all four supports (6) simultaneously along and perpendicularly to its longitudinal axis. As afore said, each support enables such a movement by sliding the housing-basis (6.3) over the support pad (6.4).

Levelling with task to achieve the zero longitudinal inclination of the pre-cast element (3) is performed at supports (6) by a pair of hydraulic presses (6.1). Acting simultaneously, the said pair of the presses (6.1) at each end of the element can increase or decrease its

vertical level. If the precast element occurred to be inclined laterally, than one single pressure at one side of the rod, is activated to perform the slight correction. Thus arranged plurality of longitudinal socket elements hanging upon rods form accurate positioned longitudinal socket for entire foundation which can be again and again  
5 corrected until the desired accuracy is achieved. The said accuracy of the longitudinal socket is of a great importance in later stage of constructing walls, when panels are mounted and levelled in the upright position.

Finally, the complete longitudinal socket grove being perfectly levelled, hanging over the trench, is poured a fresh concrete to be incorporated to the ground by a third group of  
10 workers, which, following the levelling group finish the job vibrating and screeding. The poured in site strip footing (4) fills the gap between the precast longitudinal socket (3), hanging firmly fixed at some distance of the trench bottom, and the bottom of the trench (8). After the strip footing (4) concrete is hardened, hoisting/levelling devices (5) are removed.